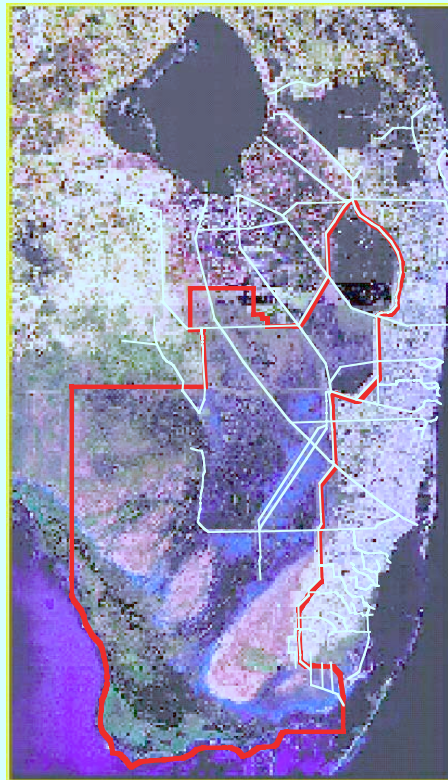


# Response to Reviews of the Everglades Landscape Model

## Everglades Landscape Model



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# Oct 2 Goals

## Response to ELM reviewer comments

- **Part I: Overview of responses to topics**
  - § **Summarize comments**
    - High importance
    - Lesser importance
- **Part II: Details of responses to topics**
  - § **General/conceptual**
  - § **Detailed algorithm**
  - § **Detailed data**
- **Part III: Discussion and next steps**

# **Everglades Landscape Model (ELM) Objectives**

**Integrate hydrology, biology and nutrient cycling in spatially explicit simulation**

- **Understand ecosystem dynamics at regional scale**
- **Develop predictions of landscape response to altered water & nutrient management**
- **One tool to aid in Everglades restoration**

## ELM Objectives

- dynamic, process-oriented, spatially distributed simulation tool to evaluate Everglades ecological dynamics.
- calibrated to effectively match the observed data on water stage and total phosphorus concentration in the water column at some 40 point locations distributed throughout the greater Everglades.
- earlier versions of ELM have also demonstrated good calibration for various soil attributes, periphyton biomass & succession, and macrophyte biomass & succession.
- as such, it is also effective as an aid in synthesis of the complex spatio-temporal dynamics of the Everglades system.
- objective is to be available as a tool to evaluate hydrology and phosphorus water quality at the regional and fine scale for CERP Projects, CERP RECOVER, and other Everglades Project evaluations such as CSOP

## Review Objectives

- initiated by the RECOVER Model Refinement Team (MRT) as part of a series of model reviews.
- SFWMM is being reviewed concurrent with ELM. Plans for reviewing other regional models such as the ATLSS suite of models are in development.
- MRT will likely develop a consensus on the extent to which each model should be used in CERP design and optimization.
- MRT review was conducted by agency scientists and engineers with broad expertise in various disciplines, and designed to provide constructive, not necessarily independent, assessments of the ELMs' ability to provide useful simulations of Everglades management alternatives.

## Response: Overall Summary

- eight reviewers provided valuable input from a spectrum of disciplines.
- ELM developers have carefully considered and replied to all recommendations made by the reviewers.
- at least one reviewer made it very clear that the ELM is an indispensable tool for ecological assessments, while another reviewer made it clear that the ELM should not be applied in its current version.
- majority recognized the critical need for a regional simulation tool like ELM, to evaluate ecological responses to restoration alternatives, and they approved of the ELM with reservations.
- most questions focused on details of performance in specific locations, the efficacy of particular numerical approaches, and the use of input data.

## Response: Overall Summary (con't)

- clarify (in response document) all aspects of the ELM that caused concern for reviewers.
- replies include quantitative assessments of prior model runs, along with new model runs at a variety of spatial scales.
- although extremely constrained by time (some of our responses could be expanded), we believe that the full scope of the reviewers comments on this version of ELM have been addressed.
  - § time ran out before we could address a handfull of reviewer comments on aspects of the ELM capabilities that will be available in future versions.
- demonstrate that the ELM is an appropriate tool for the task.

## Response: General/Conceptual

- concur with most comments, particularly the positive ones such as “appears to work well to predict regional and sub-regional trends” or “is an indispensable tool”, or “ready for application to scenario evaluation”.
- contrary to some comments, we feel that the water quality calibration is sound and indicative of ELM’s utility for surface water quality assessments throughout the Everglades. We make the point that the strength of the ELM is that it is explicitly designed for the varied environments of the Everglades wetlands and it is not constrained by designs of “traditional” water quality models.



## Response: General/Conceptual (con't)

- one reviewer felt that the calibration results of ELM captured the spatial and temporal water quality and quantity trends for a 17-year period when hydrologic extremes (droughts and floods) were observed.
- another reviewer took the opposite view and flatly stated that the ELM must extend its historical simulation from 1979-95 to include a 1996-2000 “validation”, demonstrating its (continued good) level of performance.
  - § in actuality, no model of natural systems can be validated and we present modern modeling views of determining the level of confidence in model applications, and show that the wide range of environmental conditions under which ELM has demonstrated a high level of performance.

## Response: General/Conceptual (con't)

- concur with reviewer(s) who would like to see an updated, multi-scale sensitivity analysis that we undertook on an earlier ELM version.
  - § this, and related uncertainty statistical evaluations, will provide ELM users with enhanced understanding of its utility. This was not expressed as a “Critical recommendation”, and we concur that such analyses are highly desirable, but not absolutely essential to preclude the application of ELM in its current form.
- policy concerns regarding the staffing level of the ELM team, wondering if the ELM had adequate resources to meet all of the goals.
  - § while an increased pool of experts to work with ELM would accelerate further refinements (in vegetation succession and other performance measures), we have a fully developed tool, with robust automated “post-processing” and web-posting routines that can turn model applications around very rapidly, even at our current staffing levels.

## Response: General/Conceptual (con't)

- while some reviewers were very complimentary on our extensive web-based documentation that covers virtually all aspects of ELM, one reviewer expressed (not as a Critical Recommendation) concern that more documentation would be beneficial. We concur that we should ensure that every feasible aspect of the ELM should be transparently documented.
- sufficiently accurate data on boundary conditions is a concern of most models.
  - § while some short periods of time have less model accuracy than others in some locations, the demonstrated regional calibration performance, along with the variety of subregional model tests we have conducted, provided strong evidence that ELM responds appropriately to a variety of external forcings.

## Response: Algorithms

- it may be inferred that the reviewers felt that the ELM generally had appropriate algorithms relative to its objectives.
  - § however, while one reviewer deemed the model algorithms capable of providing a “good understanding of the Everglades at the ecosystem level”, another reviewer said that the ELM needs a lot of work to be useable.
- questions were raised whether the ELM had numerical dispersion errors in its fluxing routines for nutrients in surface water, along with related concerns regarding the predicted velocities.
  - § because numerical dispersion is explicitly associated with spatio-temporal scale of the model, we developed three (100, 500, 1000 m) scales of implementation for a short-term, worst-case model “stress test”.
  - § from these scaling evaluations using a conservative tracer, and long term simulations of tracer and phosphorus distributions, we concluded that numerical dispersion did not introduce significant biases to ELM results.
  - § flow velocities are consistent with available information on water budgets and nutrient gradients, though we do not have the measured velocities or tracer observations for direct verification.

## Response: Algorithms (con't)

- one reviewer had harsh criticisms of two particular algorithms used in ELM hydrology: calculation of ET and Manning's n.
  - § we demonstrated that, rather than being “archaic” and lacking a south Florida basis, these (published) algorithms represented innovative responses to particular needs of this regional model, and are fully supported by recent advances in research results.
- algorithms in ELM “are in accord with the best understanding of what the major processes are in a typical wetland ecosystem”, as one reviewer put it. There were a number of questions asking for clarification on some algorithm dynamics (to which we replied), and some questions that were actually related to outdated (published) routines in earlier versions.
- ELM is truly innovative, being an ecological simulation that fully integrates dynamic hydrology, biogeochemistry, and biology of a complex system across a heterogeneous landscape.

## Response: Data

- a reviewer questioned whether the ELM uses time-varying concentrations in boundary condition inflows.
  - § we presented the method employed to do so for CERP project evaluations, but are interested in using DMSTA output when available.
- significant concerns on the number of parameters used in ELM, and the ability to support those parameters with data.
  - § discussed the manner in which the ELM was designed specifically to incorporate the basic processes responsible for general ecosystem dynamics, constraining the mechanistic level of detail to match that for which field and lab studies were available or pending.

## Response: Data

- There were questions on the vegetation and soil mapping data that are in use by ELM.
  - § these data are the best available, and appear to properly represent the characteristics of the landscape at the spatial grain of the ELM.
- Adequate data on boundary conditions are always an issue with simulation models.
  - § we have made every effort to ensure quality in those data, and are making use of improved data sources as they become available.
  - § ELM performance shows occasional periods when the model does not match observations, but the overall performance indicates the model can be applied to evaluate alternative management scenarios.